The University of Chicago

AN EXPERIMENTAL STUDY OF EYE-MOVEMENTS IN THE SILENT READING OF CHINESE

A PART OF A DISSERTATION SUBMITTED TO THE FACULTY OF THE DIVISION OF THE SOCIAL SCIENCES IN CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATION

1933

By

FUNG CHIAI WANG

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CHAPTER I
PROBLEMS AND METHODS OF INVESTIGATIONS

The characteristics of the Chinese language.- In order to obtain a clear idea of the problems involved in the reading of Chinese, it is necessary to keep in mind some of the characteristics of the language. A Chinese written word is usually perceived as a whole and may be considered as the smallest unit of the language. The form of Chinese written words, unlike English words which may be long or short, is fairly constant; it is always a square. Thus in a printed Chinese text, all words occupy the same space, regardless of the number of strokes each word contains.

Chinese written words are not phonetic; that is, they are not formed by phonetic letters. Each written word is a mono-syllabic symbol, formed by different kinds of strokes. The number of strokes in a single word varies from one to fifty-two. Most of the common words, however, contain less than fourteen strokes.

Chinese words do not have inflections, such as tense (which is indicated by using adverbs), case (which is usually indicated by the position of the noun or pronoun in relation with other parts of the sentence), and so on. The classification of parts of speech in Chinese is not definite; some words may be used as a noun, a verb, an adjective, or even an adverb.

There are two kinds of phrases in the Chinese language: the historical phrase and the grammatical phrase. The historical phrase derives its meaning from some historical or classical reference. The individual words of which the phrase is composed do not contribute directly to its meaning, but are simply cues for something else. For example, in the sentence, "He has reached the age of 'no doubt'.", the phrase 'no doubt' derives its meaning from a statement, made by Confucius: "When I was forty years of age, I had no doubt in making any kind of decision." Hence 'no doubt' means forty years of age. Grammatical phrases are formed according to certain principles of grammar. The most common type is the compound phrase, which is usually composed of two words. Compound phrases are sometimes called "terms" or "words", and ordinary Chinese words are called "characters".

Clauses and sentences are units of the Chinese language

more complex than phrases. The order of the different parts of a sentence is very important due to lack of inflection of the language. The usual order is subject, verb, and object or compliment, but condensed expressions are quite common. Sometimes the subject or even the verb is omitted in condensed expressions.

There are two different forms of the Chinese language, literary and vernacular. Literary Chinese is a classical language, used only in writing; vernacular Chinese is a spoken language, now used both in speaking and in writing. The development of the vernacular dated back hundreds of years, but the movement advocating the use of the vernacular as a formal written language to take the place of the literary Chinese has a history of less than twenty years. Although literary Chinese still predominates, vernacular Chinese seems to gain ground consistently. One of the most significant changes is the adoption of the vernacular and the abolition of literary Chinese in elementary schools. In secondary schools and colleges, both vernacular and literary Chinese are included in the programs of study.

The chief differences between literary and vernacular Chinese are as follows: first, they are different in vocabulary. Second, they are different in the use of phrases; literary Chinese contains more historical phrases, while vernacular Chinese contains more compound phrases. Third, they are different in rhetorical expressions; literary Chinese contains more metaphors and other rhetorical expressions, while vernacular contains more straightforward statements. Fourth, they are different in the degree of compactness; condensed expressions occur more frequently in literary Chinese than in vernacular Chinese.

There are two different forms of printing: the vertical alignment and the horizontal alignment. The old Chinese books were printed in the vertical form. Words were arranged in columns from the top of the page to the bottom and the columns were arranged from the right to the left. The new form of printing, the horizontal alignment, has been introduced quite recently. This form of printing is almost the same as that of English. The vertical alignment is still the predominant form of printing.

Problems for the present investigation.- It is easy to see from the brief description just given that certain reading problems are peculiar to the Chinese language. The present investigation aims to determine: first, the differences which appear in the reading of literary and vernacular Chinese; second, the differences which appear in the reading of fiction and essay materials; and third, the characteristics of certain different methods of reading, namely rapid, normal, and careful reading.

The first problem is to determine the effect of the

changes in the form of the language upon reading. Since literary and vernacular are two different forms of the same language, identical ideas may be expressed in both forms. When the contents or ideas of both forms are of the same type and approximately equal in difficulty, how are the two forms read? What is the psychological explanation of such differences as occur?

The second problem is to determine the effect of changes in content upon reading. The difference between fiction and essay materials lies in the nature of the content: one is narration, and the other is the presentation of arguments or useful information. When the form of the language is kept constant, which type of material, fiction or essay, is more difficult to read? What is the psychological explanation of the findings?

The third problem is to determine the effect of changes in methods upon reading when both the form and content of the reading materials are kept constant. Given the same type of material, the reader's attitude towards it may be different at different times. He may read very carefully, or rapidly, depending upon the mental set at the time. It is commonly assumed that the same reader by changing his method from careful reading to rapid reading will increase his rate but decrease his comprehension; in other words, his rate will be increased at the expense of his comprehension. To what extent is this assumption true?

There are two other closely related problems. First, do rapid readers have better comprehension than slow readers? Second, are rapid readers in one type of reading rapid readers in other types of reading? These two problems are different; but since they both concern rate and comprehension, they will be included in the present investigation.

Methods of investigation.- Two different techniques, photographic and testing, were used in the present investigation. The apparatus which was used for photographing the eye-movements by means of a reflected pencil of light was essentially the same as that used by previous investigators in the Laboratory of the University of Chicago. A brief description and a statement of the more recent modifications were given in a monograph by Buswell.[1] The methods of securing and plotting photographic records have been described fully in another monograph by the same author.[2]

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[1]G. T. Buswell, Diagnostic Studies in Arithmetic, pp. 11-14. Supplementary Educational Monographs, No. 30. Chicago: Department of Education, University of Chicago, 1926.

[2]G. T. Buswell, An Experimental Study of Eye-Voice Span in Reading, pp. 3, 7. Supplementary Educational Monographs, No. 17. Chicago: Department of Education, University of Chicago, 1920.

In conducting the testing experiment, the amount of reading material was kept constant for the whole group, while the reading time was the variable. Each individual was allowed to spend just as much time as he needed. A stop watch was used to keep time and questions were asked after the reading to check comprehension.

These two divisions of the present investigation were conducted separately, but the purpose of investigation was essentially the same. The reading materials for the experiments were selected to insure similar content and approximately equal difficulty in the two divisions of the study. All reading materials are general in character and could be used with high school pupils or college students but not with elementary school pupils.

The seventy-one subjects in the present investigation were all university students. Both photographic and test records were obtained for twenty-nine subjects. Twenty-one subjects had photographic records only and the remaining twenty-one subjects had only test records. Thus there were fifty subjects for each type of record. Forty-one of the seventy-one subjects were students at the University of Chicago, the remaining being students from other American universities. All but seven of the subjects were graduate students. The academic interests of these students were fairly well distributed in different fields: about one half were in the division of social sciences, and one half in the division of natural sciences. Their educational backgrounds were fairly comparable. All of them went to school under the modern system, and had at least passed the junior college level before they came to America. On the whole this group had more formal training in reading literary Chinese than in reading vernacular Chinese. Their training in reading vernacular was chiefly incidental. Fiction was not allowed to be read in schools until quite recently. Consequently, the majority of the subjects had more contact with the essay type of Chinese than with Chinese fiction.

Ten passages were selected as the reading material for the photographic records. Each passage had six lines, and each line was four inches in length, containing exactly 20 words, making a total number of 120 words per passage. The passages were arranged horizontally with identical margins and spacings. The plates shown are actual reading materials with the spacing between lines enlarged for the convenience of plotting.

The ten passages were arranged in five pairs, A and B, C and D, E and F, G and H, and I and J. A, C, E, G, and I were literary passages, while B, D, F, H, and J were vernacular passages. The first four pairs were matched passages, that is,

the passages in each pair were so chosen that they were different only in form (literary and vernacular). The nature of the content and the level of difficulty were approximately the same. Passages C and D consisted in fiction materials, while the other three pairs were essay materials. The samples used were selected from four sources. Passages A, B, F, and H were selected from the Works of Dr. Sun Yat-Sen; passages E and G, from Chen Ke-May's letter to Wong Ka-Kiang; passage C, from The Chinese Wonder Book, and passage D, from Lao-Zan's Travels. All of these works are popular books and their authors have been recognized as of the highest rank.

Passage I was selected from a classical book, called Chung-Tzu, and passage J was a vernacular translation, so that in this pair the nature of the content was identical. The material was of the essay type.

In order to give the subject an opportunity to become accustomed to reading before the camera, a practice passage was provided. The subject was asked to read the practice passage under exactly the same conditions as those under which he was later to read the passages used in the investigation, except that the photograph of his eye-movements was not taken. This, of course, the subject did not know. After the practice passage came normal reading, rapid reading, and careful reading. With a few exceptions, the passages were read according to the alphabetic order, namely, A, B, C, D, E, F, G, and H.

Passages I and J were read at a normal rate. Since this part of the experiment started later, some of these pictures were taken at a separate sitting. As the content of these two passages was exactly the same, the order of reading might influence reading efficiency. The subjects were divided into two equal groups to control this factor. One group read in the order of I and J, the other group read in the order of J and I.

Instructions for reading were given with the purpose of inducing a certain attitude on the part of the reader. They were given in Chinese, the exact translation is as follows: for normal reading, "Read this passage silently."; for rapid reading, "Read this passage rapidly, just to find out what it is about."; and for careful reading, "Read this passage very carefully so that you can answer any questions about it."

Comprehension was not tested after the reading. If comprehension tests had been given after the reading of each passage, the subject would usually have changed his head position, and the camera would have had to be readjusted for the next picture. If ten passages were read at one sitting under such conditions, the camera would have had to be adjusted ten times.

Such a procedure requires too much time and would likely disturb the subject too much to secure valid samples of his reading. If the tests had been given after the subject had finished all of the passages, the order of reading would have exercised an enormous influence on comprehension and the results would probably have had no significant value for comparative purposes.

Ten selections were chosen as the reading material for the testing technique. Each selection contained about 500 words and was arranged vertically. Since Chinese students on the whole read vertical alignment better than horizontal alignment, the difference in the type of alignment would affect any comparison of test records with photographic records. This difficulty was avoided in the present investigation by using the two methods quite separately. Comparisons between different methods of reading or between different types of materials are based either wholly on test records or wholly on photographic records, the difference in alignment therefore does not affect the results.

Selections of literary Chinese for the testing technique were taken from the same sources from which the reading materials for the photographic technique were chosen. Thus selections No. 1 and No. 2, literary essays, were chosen from the Works of Dr. Sun Yat-Sen; selections No. 3, No. 4, and No. 9, literary fiction, were chosen from the Chinese Wonder Book.

Selections of vernacular Chinese for the testing technique were taken from different sources. Selections No. 5 and No. 6, vernacular essays, written by different authors, were selected from a popular magazine, called the New Moon. Selections No. 7 and No. 8, vernacular fiction, were selected from the Stories of Pedants; selection No. 10, vernacular fiction, was selected from the Dreams of Red Chambers.

Eight selections were used for careful reading. They represent four different types of material, namely, literary essays, vernacular essays, literary fiction, and vernacular fiction. Each type of material was represented by two similar selections for the purpose of testing whether there is any difference in rate and comprehension in reading the same type of material. Two selections were used for rapid reading: the one literary fiction, and the other vernacular fiction.

The subjects were divided into two equal groups. The first group read according to the number of the selections, namely, 1, 2, 3, 4, 5, 6, 7, 8 (careful reading), 9, and 10 (rapid reading). The second group read in the reversed order, namely, 8, 7, 6, 5, 4, 3, 2, 1 (careful reading), 10, and 9 (rapid reading). The reason for this change of order was that in reading two similar selections, as the experimenter observed,

the comprehension of the first selection sometimes affected the reading of the second selection.

Two selections for rapid reading in the first group were used as careful reading material in the second group; two selections for careful reading in the first group were used as rapid reading material for the second group. The interchange of reading material was introduced to offset errors due to the selection of material and to reduce any inequalities as a result of the tests when rapid and careful reading were compared.

A true-false test, consisting of ten items, was constructed for each selection. It was found that ten items covered the essential points of the material. Care was taken to make the test for one selection comparable with that for the other, although there was no evidence to show that these tests were all equal in difficulty. No attempt was made to weight the individual items in scoring, because it was difficult to determine whether a large percentage of failure on a particular item was due to the nature of the test or to the nature of the reading material.

Reading for the testing technique was done in a private study room. Reading conditions were kept constant. The beginning and ending of a selection were marked in the book. The instruction for careful reading was: "Here are several selections. Read them carefully. After reading, you will be given a true-false test, consisting of ten items." For rapid reading, the instruction was: "Here are two selections. Read them very rapidly. After reading, you will be given a true-false test, consisting of ten items."

The subject was given the true-false test after the reading and was told that no time record would be taken.

Treatment of data.- Rate and comprehension for the reading of ten long selections for 50 subjects were determined by the testing technique. Rate was measured in terms of number of words read per second. Comprehension was measured in terms of correct answers, wrong answers were disregarded. Each correct answer was given 10 points, thus the highest possible score was 100, and the lowest possible score was zero.

Eye-movement records in reading short passages for 50 subjects were obtained by the photographic technique. Of these 50 subjects, 23 had ten pictures each; 14 had eight pictures each; 10 had six pictures each, and 3 had four pictures each. The number of pictures for each passage was as follows: for passages A, B, C, and D, 50; for passage E, 47; for passage F, 37; for passage G, 45; for passage H, 35; for passages I and J, 25. The total number of pictures was 414. The statistical tables showing the average practice were based on these 414 pictures. After

the presentation of the general tables, individual records and plates are shown, so that individual variations could be analyzed.

In computing the average for each measure of eye-movements the first line was discarded. Thus for each individual subject, the average of each measure was based on five lines only. The average measures for the whole group were calculated from these averages for each individual.

Six items were secured from the eye-movement records, namely the average number of fixation per line, the average number of regressive movements per line, the average duration per fixation, the average duration per word, the average number of words per fixation, and the average number of words per second. The average duration per word and the average number of words per second are two different measures of rate, while the average number of fixations per line and the average duration per fixation are measures of the factors conditioning rate. Two readers may have the same rate of reading, but the factors conditioning their rate may be entirely different. One reader is slow because he has an excessive number of fixations per line, another is slow because he has an excessive length of fixation-duration. Thus the eye-movement records furnish data for more detailed individual analysis.

The average number of regressive movements indicates the character of the eye-movements. For example, two readers may have the same number of fixations per line, but the character of their eye-movements may be entirely different: one may have a series of regular forward-going movements, the other may have a series of oscillating and irregular movements. The differences indicate that their habits of reading and their inner mental processes are entirely different although the gross results, as shown by the number of fixations per line, are the same.

The average number of words per fixation shows the significance of the difference in the average number of fixations per line. For example, here are two pairs of subjects. For the first pair, one has on the average 20 fixations per line; the other 18. The difference between these subjects is two fixations per line. For the second pair of subjects, one has 10 fixations per line, the other, 8; likewise a difference of two fixations per line. But a difference of two fixations means something entirely different for these two pairs of subjects when a comparison is made on the basis of number of words per fixation. Thus, when the number of words per line is constant, say 20; then the difference between the first pair of subjects is only .11 word per fixation (1.11 and 1.00 words respectively); while the difference between the second pair is .50 word per fixation

(2.50 and 2.00 words respectively).

Thus the eye-movement records furnish data for a detailed quantitative and qualitative analysis. Furthermore, by locating the clusters of close-fixations and regressive movements, it is possible to determine the types of difficulty which the reader has encountered. The eye-movement records, therefore, furnish objective evidence for an analysis of reading difficulty.

CHAPTER II
A COMPARISON OF LITERARY AND VERNACULAR CHINESE

On the basis of the matched passages.- Table I presents the mean and standard deviation of measures of eye-movements in reading the four pairs of matched passages of literary and vernacular Chinese. The facts presented in Table I justify the following conclusions:

(1) Adult Chinese students read vernacular Chinese more efficiently than they read literary Chinese. The average number of fixations per line for literary and vernacular essays is as follows respectively: (a) rapid reading, 10.9 and 9.2; (b) normal reading, 14.5 and 12.7; and (c) careful reading, 17.6 and 13.8. The average difference is about two fixations per line. The average number of words per second for literary and vernacular essay is as follows respectively: (a) rapid reading, 7.2 and 8.5; (b) normal reading, 5.0 and 5.8; and (c) careful reading, 3.9 and 5.2. The average difference is about one word per second. The average number of fixations for the normal reading of literary and vernacular fiction (passages C and D) is 15.3 and 13.9 respectively; the average number of words per second is 4.7 and 5.2 respectively.

(2) When the three methods of reading are compared, the differences between literary and vernacular Chinese are greater in careful reading than either in normal or in rapid reading (with the exception of the measure of the average number of words per second). These differences may be due to the fact that some difficult parts in literary Chinese, which were overlooked in normal and rapid reading, became the center of attention when careful reading was required.

(3) The usual adjustment to the change from literary to vernacular materials is a major reduction in the average number of fixation per line and a slight reduction in the average duration per fixation.

(4) The difference in the variation of ability between the reading of literary and vernacular Chinese depends upon the method of measurements. The standard deviations are greater for vernacular Chinese than for literary Chinese when measurements are based on the average number of words per fixation and the average number of words per second. Since the nature of these two measurements increases individual variations to a greater

TABLE I

THE MEAN AND STANDARD DEVIATION OF THE MEASURES OF EYE-MOVEMENTS IN READING THE DIFFERENT PASSAGES OF LITERARY AND VERNACULAR CHINESE

Passages	Measures	Fixat. per Line	Regress. per Line	Durat. per Fixat.	Durat. per Word	Words per Fixat.	Words per Second
Normal							
A. LE.	Mean	14.52	1.54	7.22	5.46	1.50	5.01
B. VE.	Mean	12.71	1.07	7.03	4.72	1.69	5.78
Diff.		1.81	.47	.19	.74	.19	.77
		±.21	±.07	±.04	±.09	±.03	±.09
Normal							
C. LF.	Mean	15.28	1.88	7.41	5.91	1.42	4.65
D. VF.	Mean	13.89	1.50	7.45	5.41	1.59	5.23
Diff.		1.39	.38	.04	.50	.17	.58
		±.15	±.07	±.04	±.08	±.03	±.10
Rapid							
E. LE.	Mean	10.90	1.23	7.06	4.10	2.16	7.15
F. VE.	Mean	9.17	.74	6.86	3.38	2.52	8.54
Diff.		1.73	.49	.20	.72	.36	1.39
		±.25	±.11	±.07	±.12	±.05	±.19
Careful							
G. LE.	Mean	17.61	3.11	7.70	7.23	1.28	3.94
H. VE.	Mean	13.78	1.78	7.26	5.37	1.58	5.22
Diff.		3.83	1.33	.44	1.86	.30	1.28
		±.33	±.16	±.07	±.15	±.05	±.11
Normal							
A. LE.	S. D.	4.02	1.27	.84	1.57	.46	1.57
B. VE.	S. D.	2.83	.77	.82	1.40	.52	1.95
Diff.		1.19	.50	.02	.17	.06	.38
		±.33	±.10	±.08	±.14	±.05	±.17
Normal							
C. LF.	S. D.	3.96	1.36	.89	1.72	.44	1.60
D. VF.	S. D.	4.10	1.24	.91	1.80	.58	2.11
Diff.		.14	.12	.02	.08	.14	.51
		±.39	±.12	±.08	±.17	±.05	±.18
Rapid							
E. LE.	S. D.	4.14	1.29	.94	1.47	.97	3.07
F. VE.	S. D.	3.34	.70	.94	1.36	1.11	3.52
Diff.		.80	.59	.00	.11	.14	.45
		±.42	±.12	±.10	±.16	±.12	±.37
Careful							
G. LE.	S. D.	5.46	2.46	.91	2.49	.49	1.57
H. VE.	S. D.	4.04	1.76	1.09	1.77	.52	1.92
Diff.		1.42	.72	.18	.72	.03	.35
		±.56	±.24	±.11	±.24	±.06	±.20

extent for the fast readers than for the slow readers, these measurements are unsuited for comparing the dispersion between literary and vernacular Chinese.

The standard deviations are, on the whole, smaller for vernacular essays than for literary essays when measurements are based on the average number of fixations per line, average number of regressive movements per line, average duration per fixation, and average duration per word, as shown in Table I. Consistent differences in standard deviation disappear when literary fiction is compared with vernacular fiction. Probably the variations in the ability to read essays are greater in literary Chinese than in vernacular Chinese, while the variations in the ability to read fiction are approximately the same for both forms of the language.

The differences in standard deviation between literary and vernacular Chinese are, in general, greater in careful reading than either in normal or in rapid reading. It is probable that careful reading of literary Chinese increases the range of individual variations to a greater extent than the careful reading of vernacular Chinese.

On the basis of the original and translated passages.- The number and nature of the ideas contained in the reading materials were kept constant by using an original literary passage and its vernacular translation. The form of the language was the only variable in this pair of passages. These two passages were read at a normal rate. The differences in the six measures between these two passages are shown in Table II. The difference in average number of fixations per line was 1.3, and the difference

TABLE II

THE MEAN AND STANDARD DEVIATION OF THE MEASURES OF EYE-MOVEMENTS IN READING THE ORIGINAL AND TRANSLATED PASSAGES

Passages	Measures	Fixat. per Line	Regress. per Line	Durat. per Fixat.	Durat. per Word	Words per Fixat.	Words per Second
I. LE.	Mean	17.34	2.75	7.73	6.88	1.22	3.86
J. VE.	Mean	16.03	2.21	7.88	6.49	1.32	4.14
Diff.		1.31 ±.31	.54 ±.15	.15 ±.08	.39 ±.14	.10 ±.02	.28 ±.12
I. LE.	S. D.	4.58	2.02	.84	1.65	.32	.99
J. VE.	S. D.	4.20	1.69	1.09	1.77	.33	1.21
Diff.		.38 ±.59	.33 ±.25	.25 ±.13	.12 ±.23	.01 ±.04	.22 ±.15

in average number of words per second was .30. While these figures still indicate the superiority of vernacular Chinese over literary Chinese, the size of the difference between these two forms was reduced considerably.

There are two possible explanations for this reduction, the control of the number of the ideas or the control of the nature of ideas. It will be shown in the next section that the errors due to selection of materials are small. The nature of ideas contained is probably of no great importance. It is quite likely that the number of ideas contained in the passage is an important factor. When the number of ideas is constant, the vernacular passages are usually more verbose than the literary passages. When it is required to express the same ideas by the same number of words, the vernacular passage has to be just as condensed as the original literary passage. The possession of this common element of compactness probably reduces the differences between the readings of these two forms of Chinese. This conclusion is supported by the fact that condensed forms of expression, as shown in the individual records, are a source of difficulty commonly encountered in reading.

On the basis of test records.- A large amount of material was read and the comprehension was checked by the testing technique. The results are shown in Table III. The subjects

TABLE III
AVERAGE RATE AND COMPREHENSION FOR THE READING OF LITERARY AND VERNACULAR CHINESE OBTAINED BY THE TESTING TECHNIQUE

Methods of Reading	Materials*	Rate (Words per Second)		Comprehension	
		Mean	S. D.	Mean	S. D.
Careful	VE.	5.36±.18	1.91±.13	84.4±1.2	12.7±0.9
	LE.	3.93±.13	1.36±.09	72.6±1.1	11.5±0.8
	Diff.	1.43±.11	.55±.16	11.8±1.3	1.2±1.2
	VF.	4.94±.18	1.91±.13	88.5±0.9	9.3±0.6
	LF.	3.75±.14	1.43±.10	80.0±1.4	14.5±1.0
	Diff.	1.19±.08	.48±.16	8.5±1.4	5.2±1.2
Rapid	VF.	7.02±.32	3.40±.23	83.0±1.2	11.9±0.8
	LF.	5.69±.35	3.62±.24	74.8±1.8	18.6±1.3
	Diff.	1.33±.25	.22±.33	8.2±2.1	6.7±0.5

*In careful reading, VE. is the average of selections No. 5 and 6; LE., the average of selections No. 1 and 2; VF., the average of selections No. 7 and 8; and LF., the average of selections No. 3 and 4. In rapid reading, VF. is the selection No. 10; and LF., the selection No. 9.

had, on the average, both a higher rate and better comprehension in reading vernacular than literary Chinese. The differences in rate and comprehension are statistically significant. The average number of words per second for the careful reading of literary and vernacular essays is 3.9 and 5.4 respectively; for the careful reading of literary and vernacular fiction, 3.8 and 4.9 respectively; and for the rapid reading of literary and vernacular fiction, 5.7 and 7.0 respectively. Thus the average difference is more than one word per second. The average comprehension score for literary and vernacular Chinese is 85 and 76 respectively, a difference of 9 points. The differences in rate and in comprehension for selections of the same type, as shown in Table IV, are in general slight and insignificant (with the exception of one case).

TABLE IV

AVERAGE RATE AND COMPREHENSION FOR THE READING OF SELECTIONS OF THE SAME TYPE OBTAINED BY THE TESTING TECHNIQUE

Materials	Rate		Comprehension	
	Mean	S. D.	Mean	S. D.
No. 1. LE.	3.90±.13	1.34±.09	66.8±1.6	16.4±1.1
No. 2. LE.	3.95±.14	1.46±.10	78.4±1.4	15.0±1.0
Difference	.05±.06	.12±.13	11.6±2.0	1.4±1.5
No. 3. LF.	3.68±.14	1.42±.10	80.2±1.4	15.0±1.0
No. 4. LF.	3.82±.14	1.43±.10	79.8±1.6	16.0±1.1
Difference	.14±.07	.01±.14	.4±1.4	1.9±1.5
No. 5. VE.	5.19±.19	1.99±.13	83.2±1.6	16.7±1.1
No. 6. VE.	5.53±.18	1.89±.13	85.6±1.4	14.4±1.0
Difference	.34±.10	.10±.18	2.4±1.7	2.3±1.5
No. 7. VF.	4.91±.19	1.99±.13	89.6±1.2	12.2±0.8
No. 8. VF.	4.98±.19	2.02±.14	87.4±1.2	12.9±0.9
Difference	.07±.08	.03±.19	2.2±1.6	0.7±1.2

The comparison of literary and vernacular Chinese by the use of matched passages, in both techniques, is based upon selections with the same number of words rather than the same number of ideas. If the number of ideas had been strictly controlled, it is probable that the difference between the literary and vernacular forms would have been reduced.

Characteristics of eye-movements.- The rhythmic progression of the eye along the printed lines characterizes the readings of both literary and vernacular Chinese for a typical college student. The regularity of the eye-movements is an

indication of the maturity of the reader. On the external side, the regularity is due in part to the fact that all words of the reading material are of the same size, occupying exactly the same space in a line.

The span of recognition is greater in reading vernacular Chinese than in reading literary Chinese, and the tendency to take a phrase as a unit of recognition is more marked in reading the former type of material. The number of words taken at one fixation by the typical readers of literary and vernacular Chinese is as follows respectively: rapid reading, 2.2 and 2.5; normal reading, 1.5 and 1.7; and careful reading, 1.3 and 1.6.

Table V and Plates 1-10 present the records of subject 1. He is a typical reader of the group. The fixations are indicated in these plates by vertical lines. The numbers at the upper ends of the vertical lines show the order of fixations; the numbers at the lower end of the vertical lines show the duration of fixations in twenty-fifths of a second. The phrases in the reading material were underlined.

TABLE V

EYE-MOVEMENT RECORDS OF SUBJECT 1

Methods	Passages	Fixat. per Line	Regress. per Line	Durat. per Fixat.	Durat. per Word	Words per Fixat.	Words per Second
Normal	A. LE.	14.8	.6	7.3	5.5	1.4	4.6
	B. VE.	13.6	.6	7.5	5.2	1.5	4.8
	C. LF.	15.8	1.4	7.6	6.2	1.3	4.0
	D. VF.	14.8	1.2	7.1	5.5	1.4	4.6
Rapid	E. LE.	9.8	.2	7.4	3.8	2.0	6.6
	F. VE.	6.6	.0	7.4	2.5	3.0	10.0
Careful	G. LE.	15.4	1.0	8.4	6.7	1.3	3.7
	H. VE.	14.2	1.0	7.7	5.6	1.4	4.5
Normal	I. LE.	17.0	2.4	8.0	7.0	1.2	3.6
	J. VE.	16.2	1.0	7.9	6.5	1.2	3.9

Individual variations.- There are wide individual variations both in the efficiency of reading literary and vernacular Chinese and in the methods of adjusting to the reading situations. There are cases who read literary Chinese better than vernacular, but none of these readers showed a consistent superiority with all of the literary passages. The adjustment made to changes from literary to vernacular materials was on the average chiefly a reduction in the number of fixations per line; although some of the subjects meet the situation by reducing the average

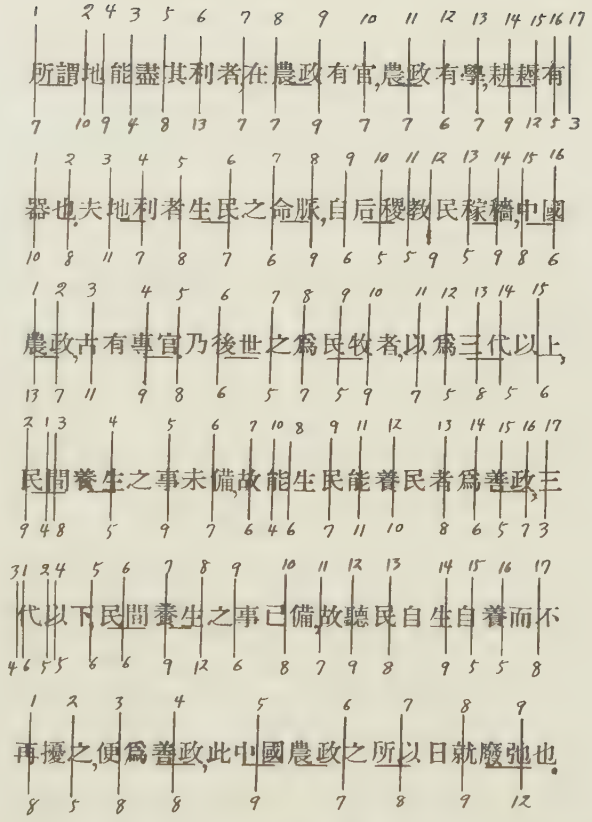

Plate 1. - Record of Subject 1, Passage A, Normal Reading of Literary Essay

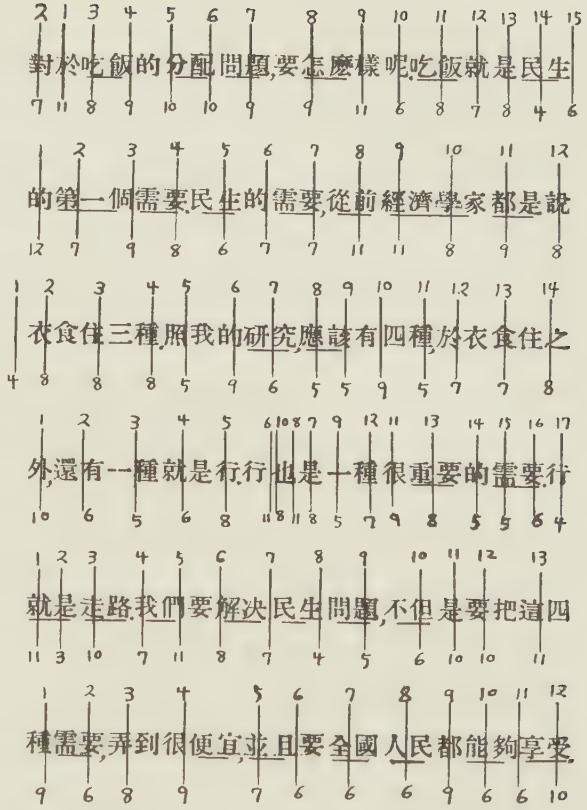

Plate 2.-Record of Subject 1, Passage B, Normal Reading of Vernacular Essay

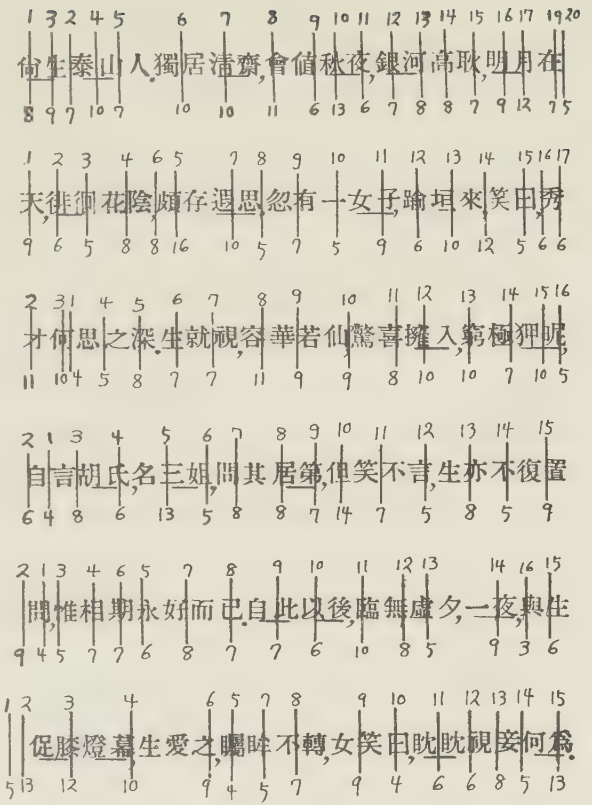

Plate 3.- Record of Subject 1, Passage C, Normal Reading of Literary Fiction

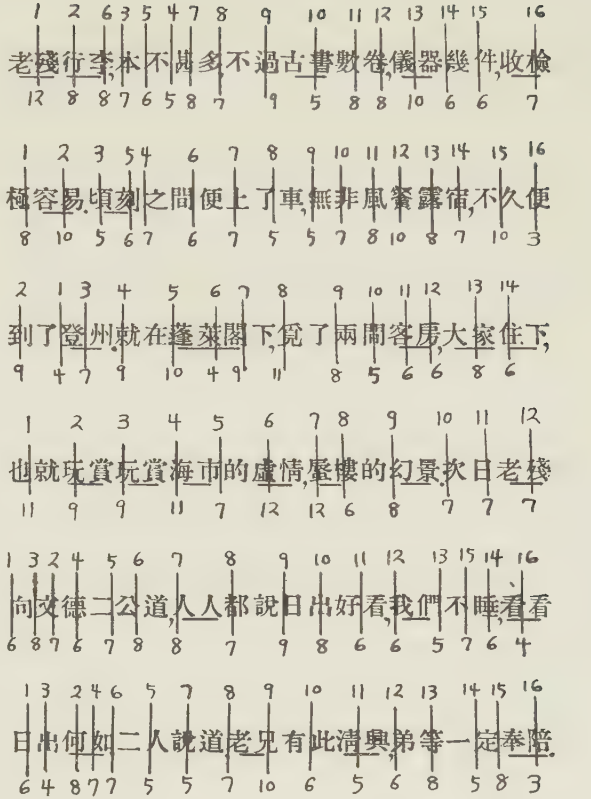

Plate 4.- Record of Subject 1, Passage D, Normal Reading of Vernacular Fiction

Plate 5.- Record of Subject 1, Passage E, Rapid Reading of Literary Essay

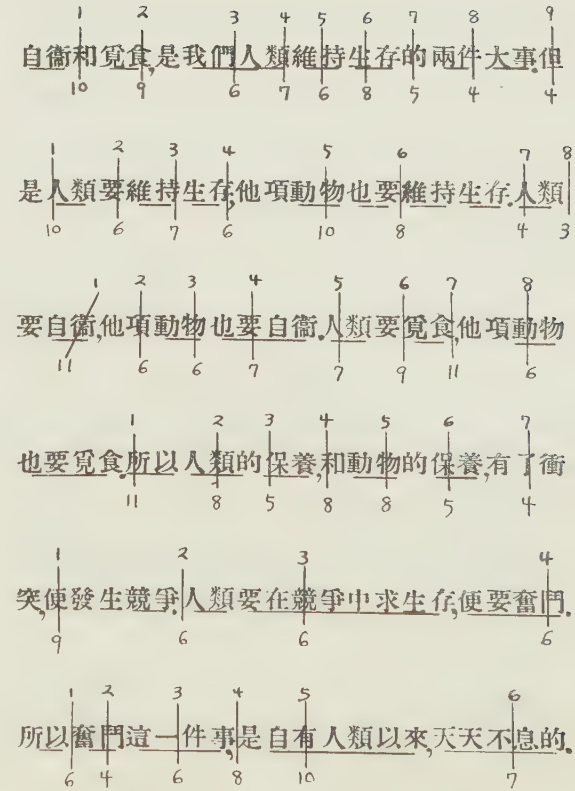

Plate 6.- Record of Subject 1, Passage F, Rapid Reading of Vernacular Essay

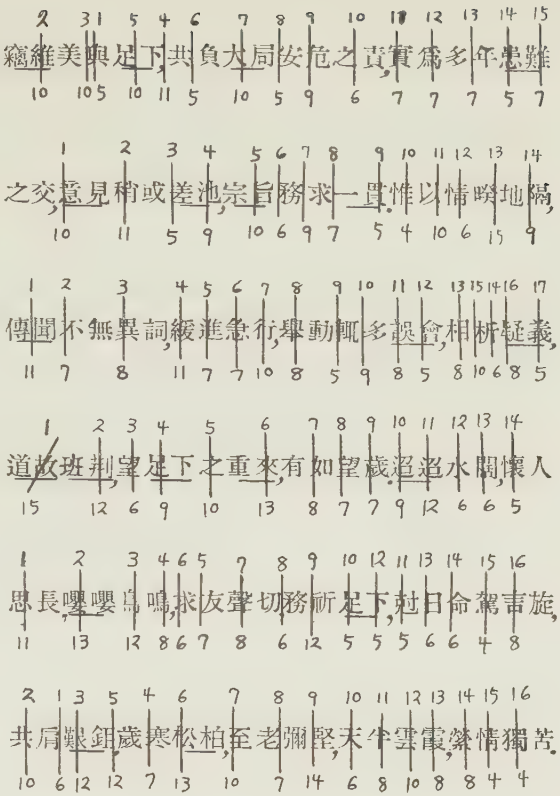

Plate 7.- Record of Subject 1, Passage G, Careful Reading of Literary Essay

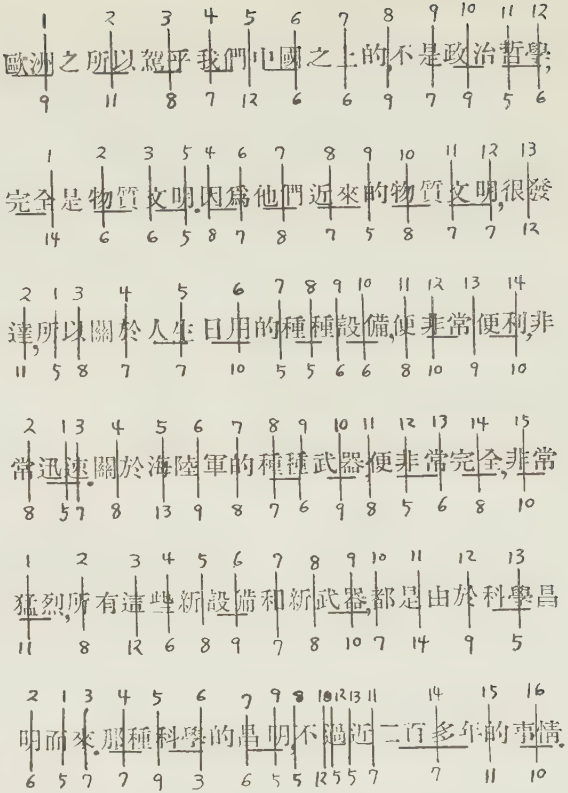

Plate 8.- Record of Subject 1, Passage H, Careful Reading of Vernacular Essay

Plate 9.- Record of Subject 1, Passage I, Normal Reading of Literary Essay

Plate 10.- Record of Subject 1, Passage J, Normal Reading of Vernacular Essay

duration per fixation. These results indicate that the reading processes are highly complex and highly individualized. A general pattern is not sufficient to explain all of these complicated processes.

Analysis of difficulties.- The analysis of difficulties is an individual affair. Certain portions of the passages are difficult for one reader but are easy for another. There are, however, several types of difficulty which are more frequently encountered by some readers. Two methods were used in locating the difficulties. First, the average number of fixations and the average duration required in reading the different lines of a passage were compared. Second, individual eye-movement records show the places where clusters of close fixations usually fall.

It was found that the first line of a passage was read with approximately 15 per cent more time and 2 more fixations than the average of the other five lines. This is a type of initial difficulty and is not closely related to the nature of the material. Hence it cannot be interpreted as due to the difficulty of the material.

A few other lines were found to be more difficult than the average. An examination of the individual records shows that clusters of close-fixations fall more frequently on these lines. By locating the clusters of close-fixations from the plates, it is possible to determine what parts of the reading material are especially difficult for some of these readers. The difficulties, as determined by this method, may be classified into six types: historical phrases, beautiful descriptions which employ metaphors and other kinds of rhetorical expressions, condensed forms of expression, key words of topic sentence or concluding sentence, unusual terms, and proper names. These classifications are in some cases not clear-cut. A particular difficulty may be analyzed into several elements. It is difficult to determine which element is the most important and to which classification the element belongs.

Due to the nature of these two forms of the language, the first three types of difficulty are much more frequently found in literary Chinese than in vernacular Chinese. This fact partly explains why adult students read vernacular Chinese more efficiently than they read literary Chinese.

CHAPTER III
A COMPARISON OF FICTION AND ESSAY MATERIALS

Rate and comprehension.- Data concerning the reading of fiction and essay material obtained by means of photographic technique are presented in Table VI. The results obtained by testing are presented in Table VII. These data show that on the basis of rate, the essay materials were read more efficiently than fiction. An analysis of photographic records shows that in normal reading the average number of words per second for literary essay and literary fiction is 5.0 and 4.7 respectively; for vernacular essay and vernacular fiction, 5.8 and 5.2 respectively. The test records show that in careful reading, the average number of words per second for literary essay and literary fiction is 3.9 and 3.8 respectively; for vernacular essay and vernacular fiction, 5.4 and 4.9 respectively.

The comprehension scores reveal that fiction is comprehended more readily than essays. The comprehension scores for literary essay and literary fiction in careful reading are 73 and 80 respectively; for vernacular essay and vernacular fiction, 84 and 89 respectively.

These comparisons are based on the gross results from the reading of fiction and essay materials. It is more important to determine the reason for a low average rate but a better average comprehension for the reading of fiction material. Several explanations can be offered. In the first place, due to lack of standardization, the tests for the essay material may be more difficult than those for fiction. This possibility is highly improbable. An examination of the tests for essay selections shows that with one exception, there is no item for which the percentage of failure is particularly high. Furthermore, the comprehension scores for the four essay selections, as shown in Table IV, are all lower than those for the fiction selections. It is difficult to see why the tests for the essay selections would be consistently more difficult than others.

A second explanation can be offered. The subject's attitude of reading fiction may be different from that of reading essay passages; they might read fiction material more carefully, hence more slowly, but with more comprehension. This condition is not likely to have operated, since all of the selections were read successively under a fairly uniform condition. There is no

TABLE VI

THE MEAN AND STANDARD DEVIATION OF MEASURES OF EYE-MOVEMENTS IN READING FICTION AND ESSAY MATERIALS

Passages	Measures	Fixat. per Line	Regress. per Line	Durat. per Fixat.	Durat. per Word	Words per Fixat.	Words per Second
C. LF.	Mean	15.28	1.88	7.41	5.91	1.42	4.65
A. LE.	Mean	14.52	1.54	7.22	5.46	1.50	5.01
Diff.		.76 ±.18	.34 ±.08	.19 ±.05	.45 ±.08	.08 ±.02	.36 ±.06
D. VF.	Mean	13.89	1.50	7.45	5.41	1.59	5.23
B. VE.	Mean	12.71	1.07	7.03	4.72	1.69	5.78
Diff.		1.18 ±.21	.43 ±.08	.42 ±.04	.69 ±.09	.10 ±.03	.55 ±.11
C. LF.	S. D.	3.96	1.36	.89	1.72	.44	1.60
A. LE.	S. D.	4.02	1.27	.84	1.57	.46	1.57
Diff.		.06 ±.38	.09 ±.13	.05 ±.08	.15 ±.16	.02 ±.04	.03 ±.16
D. VE.	S. D.	4.10	1.24	.91	1.80	.58	2.11
B. VE.	S. D.	2.83	.77	.82	1.40	.52	1.95
Diff.		1.27 ±.34	.47 ±.09	.09 ±.08	.40 ±.15	.06 ±.06	.16 ±.19

TABLE VII

AVERAGE RATE AND COMPREHENSION FOR THE READING OF FICTION AND ESSAY MATERIALS OBTAINED BY THE TESTING TECHNIQUE

Materials	Rate		Comprehension	
	Mean	S. D.	Mean	S. D.
LF.	3.75±.14	1.43±.10	80.0±1.4	14.5±1.0
LE.	3.93±.13	1.36±.09	72.6±1.1	11.5±0.8
Diff.	.18±.09	.07±.13	7.4±1.4	3.0±1.3
VF.	4.94±.18	1.91±.13	88.5±0.9	9.3±0.6
VE.	5.36±.18	1.91±.13	84.4±1.2	12.7±0.9
Diff.	.42±.10		4.1±1.3	3.4±1.1

reason to believe that the average reader would pay more attention to a particular type of material.

The third possible explanation is that the difference in test results is probably due chiefly to the fact that the difficulties encountered in reading fiction, as determined by the analysis of eye-movement records of individuals, are usually different from those encountered in reading essays. In the former, the difficulties are usually in sentence structure, unfamiliar phrases, condensed expressions, and proper names; while in the latter, the difficulties are usually in the logic of the discussion and in the understanding of historical phrases. In other words, the difficulty in the former lies chiefly in the forms of expressions, while in the latter, the difficulty lies chiefly in the content of the material. The reader, if not familiar with expressions used frequently in fiction materials, may take more time to read them, but when he has overcome these difficulties, he has really mastered the whole thing; consequently he would have better comprehension.

Relative difficulty of reading essay and fiction materials.- The relative difficulty of essay and fiction materials could not be determined absolutely, for the following reasons: This group of subjects, while having a fairly equal chance of getting in contact with the essay type of Chinese, did not have the same equal chance of getting in contact with fiction materials, because fiction was allowed to be read in schools only quite recently. In the second place, the fact that the differences in rate and in comprehension do not point in the same direction makes the comparison of reading efficiency quite complicated. All that can be said from the present evidence is that fiction and essay passages are different types of reading material and that the relative efficiency of reading them depends largely upon the training of the readers. There are individuals in the present group who read fiction more efficiently than essays.

CHAPTER IV
A COMPARISON OF DIFFERENT METHODS OF READING

General tendencies.- The effects of changes in methods on the average measures of eye-movements are presented in Table VIII. The general tendency of the group was a consistent and significant increase in rate from careful reading to rapid reading. This increase in rate is produced primarily by a reduction in the average number of fixations per line and secondarily by a reduction in the average duration per fixation.

For literary Chinese, the average number of words per second for the three methods of reading is 3.9, 5.0, and 7.2 respectively, an increase from about one to two words per second; the average number of fixations per line is 17.8, 14.5, and 10.9 respectively, a reduction of about three fixations per line; the average duration per fixation is 7.7, 7.2, 7.0 respectively, a reduction from about .2 to .5 twenty-fifth of a second. For vernacular Chinese, the average number of words per second for the three methods of reading is 5.2, 5.8, and 8.5 respectively, an increase from about one half word per second to more than two words per second; the average number of fixations per line is 13.8, 12.7, and 9.2 respectively, a reduction from one fixation per line to more than three fixations per line; the average duration per fixation is 7.3, 7.0, and 6.9 respectively, a reduction from .1 to .3 twenty-fifth of a second.

The difference between the three methods of reading is not only a difference in rate, but also a difference in the character of eye-movements. The ratio of eye-movement time to reading time and the span of recognition increases consistently from careful reading to rapid reading. The percentage, which the eye-movement time is of the total reading time, for the three methods of reading, is 3.4, 4.2, and 6.1 for literary Chinese; and 5.1, 4.9, and 7.2 for vernacular Chinese. The average number of words per fixation for the three methods of reading is 1.2, 1.5 and 2.1 for literary Chinese; and 1.6, 1.7, and 2.5 for vernacular Chinese. Thus these two measurements show a consistent increase from careful reading to rapid reading. On the other hand, the average number of regressive movements per line shows a consistent decrease from careful reading to rapid reading; the exact figures are 3.0, 1.5 and 1.1 for literary Chinese; and 1.8, 1.1, and .7 for vernacular Chinese. Clusters of close-fixations

TABLE VIII

THE EFFECT OF CHANGES IN METHOD ON THE AVERAGE MEASURES OF EYE-MOVEMENTS IN READING THE VARIOUS PASSAGES

Methods of Reading	Fixat. per Line	Regress. per Line	Durat. per Fixat.	Durat. per Word	Words per Fixat.	Words per Second
Careful, LE.	17.77	3.04	7.74	7.28	1.24	3.85
Normal, LE.	14.52	1.54	7.22	5.46	1.50	5.01
Rapid, LE.	10.90	1.12	7.00	4.06	2.11	7.15
Diff. between car. & normal	3.25 ±.30	1.50 ±.15	.52 ±.07	1.82 ±.14	.26 ±.02	1.16 ±.08
Diff. between normal & rapid	3.62 ±.25	.42 ±.10	.22 ±.06	1.40 ±.11	.61 ±.06	2.14 ±.18
Diff. between car. & rapid	6.87 ±.29	1.92 ±.14	.74 ±.05	3.22 ±.15	.87 ±.06	3.30 ±.20
Careful, VE.	13.78	1.78	7.26	5.37	1.58	5.22
Normal, VE.	12.71	1.07	7.03	4.72	1.69	5.78
Rapid, VE.	9.17	.74	6.86	3.38	2.52	8.54
Diff. between car. & normal	1.07 ±.29	.71 ±.14	.23 ±.09	.65 ±.14	.11 ±.03	.56 ±.13
Diff. between normal & rapid	3.54 ±.28	.33 ±.08	.17 ±.07	1.34 ±.14	.83 ±.08	2.76 ±.25
Diff. between car. & rapid	4.61 ±.35	1.04 ±.17	.40 ±.08	1.99 ±.16	.94 ±.10	3.32 ±.31

occur frequently in the careful reading of slow readers, less frequently in their normal reading, and very rarely in their rapid reading.

Individual variations.- Individual variations are found both in the rate of reading and in the different ways of meeting the reading situations. These differences are either quantitative or qualitative or both. Some subjects are essentially in agreement with the average of the group in their methods of adjustment with regard to the reduction of the average number of fixations per line or the average duration per fixation, but their rate for the three methods of reading differs greatly from the average of the group. This difference is quantitative. Other subjects are quite close to the average in their rate for the three methods of reading, but their methods of adjustment are entirely different from the average. This difference is qualitative. In actual practice, as shown in these individual records, the differences

are both qualitative and quantitative, since no two individuals are exactly alike in the different kinds of measurements.

Plates 11 and 12 present two sample records of subject 3, a slow reader; Plates 13 and 14, two sample records of subject 36, a rapid reader. It will be noted that Plates 11 and 13 are records for the normal reading of passage C, while Plates 12 and 14 are records for the normal reading of passage D. These records present a sharp contrast. The eye-movements for subject 3 are characterized by a narrow span of recognition, a jerky and irregular progression, and clusters of close-fixations. The eye-movement records for subject 36 are characterized by a large span of recognition, a rhythmic progression, and an absence of clusters of close fixations. These symptoms show that the mental processes involved in the reading of the same passages are entirely different for these two readers.

Table IX presents the records of two slow readers and two fast readers. Subjects 3 and 4 are both slow readers, but the factors producing their slowness are quite different. The average fixations per line and the average duration per fixation for subject 3 are all above the average; his slow rate is therefore due to a combination of these two factors. On the other hand, subject 4 had a short fixation duration for all types of reading; his slow rate is therefore entirely due to the excessive number of fixations per line. From careful reading to rapid reading, subject 4 increased his rate entirely by the reduction in the average number of fixations. From careful reading to normal reading subject 3 reduced both the average number of fixations and the average fixation-duration; from normal reading to rapid reading, his major reduction is in the average number of fixations.

Subjects 34 and 36 are both fast readers. Subject 36 is superior to the average of the group in every measure. The number of fixations per line is smaller than the average and the fixation-duration is shorter than the average. The fixation-duration for subject 34, however, is even longer than the average of the group. His high rate is therefore entirely due to the small number of fixations or large span of recognition. From normal reading to rapid reading, subject 36 reduced only the average number of fixations, while subject 34 reduced both the average number of fixations and the average fixation-duration. These facts confirm the early conclusion that reading processes are highly complex and highly individualized.

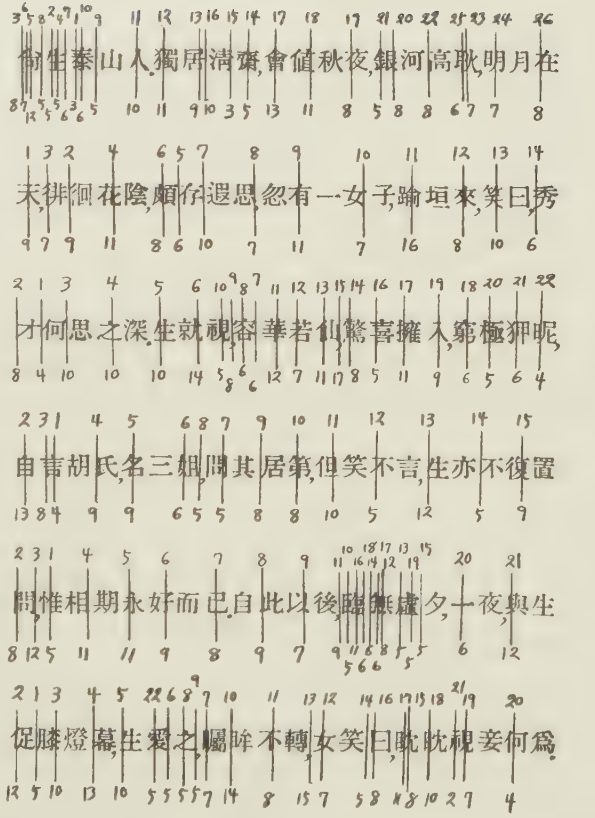

Plate 11.- Record of Subject 3, Passage C, Normal Reading of Literary Fiction

Plate 12.- Record of Subject 3, Passage D, Normal Reading of Vernacular Fiction

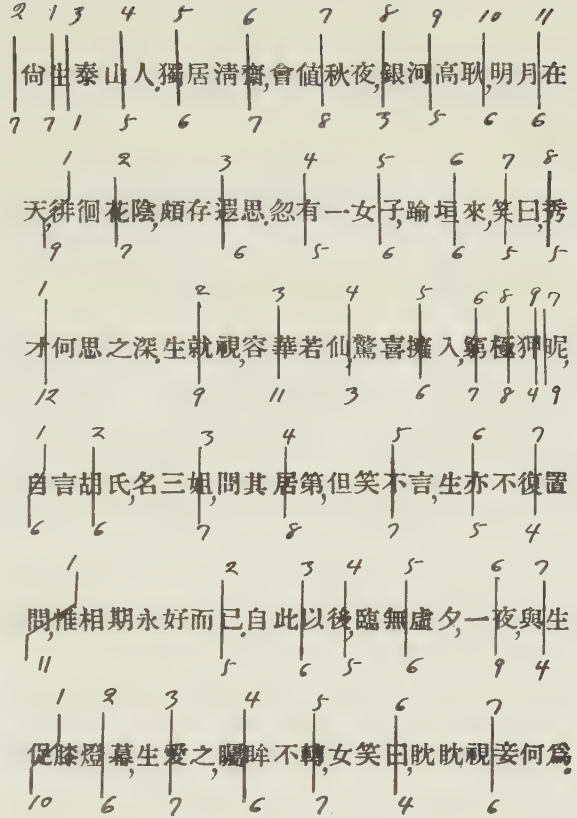

Plate 13.- Record of Subject 36, Passage C, Normal Reading Literary Fiction

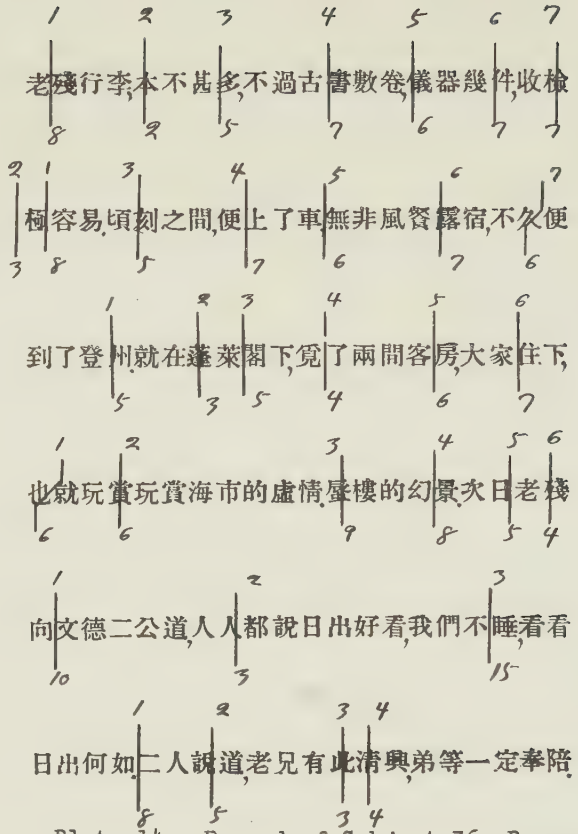

Plate 14.- Record of Subject 36, Passage D, Normal Reading of Vernacular Fiction

TABLE IX

EYE-MOVEMENT RECORDS FOR SUBJECTS 3, 4, 34 AND 36

Subject	Methods of Reading	Fixat. per Line	Regress. per Line	Durat. per Fixat.	Durat. per Word	Words per Fixat.	Words per Second
No. 3	Car. LE.	26.6	9.8	8.9	12.1	0.8	2.1
	Nor. LE.	17.0	3.0	8.2	7.0	1.2	3.6
	Rap. LE.	14.2	5.0	8.6	6.2	1.4	4.0
	Car. VE.	23.2	8.4	8.8	10.5	0.9	2.4
	Nor. VE.	15.0	2.6	8.1	6.2	1.3	4.0
	Rap. VE.	8.8	1.2	8.1	3.7	2.3	6.8
No. 4	Car. LE.	23.6	7.2	6.4	7.9	0.8	3.2
	Nor. LE.	21.0	4.6	6.6	7.1	1.0	3.5
	Rap. LE.	14.0	2.0	6.7	5.0	1.4	5.0
	Car. VE.	17.8	4.6	6.6	6.1	1.1	4.1
	Nor. VE.	16.4	3.2	6.5	5.6	1.2	4.5
	Rap. VE.	9.0	0.6	6.6	3.1	2.2	8.1
No. 34	Car. LE.	8.8	.0	8.8	4.0	2.3	6.3
	Nor. LE.	7.0	.2	7.7	2.8	2.9	8.9
	Rap. LE.	4.8	.2	7.2	1.9	4.2	13.2
	Car. VE.	10.6	.0	8.1	4.5	1.9	5.6
	Nor. VE.	9.0	.8	7.0	3.3	2.2	7.6
	Rap. VE.	4.0	.5	6.4	1.4	5.0	17.9
No. 36	Car. LE.	8.2	.8	6.6	3.2	7.4	7.8
	Nor. LE.	7.6	.2	6.0	2.7	2.6	9.3
	Rap. LE.	5.7	.0	6.0	2.1	3.5	11.9
	Car. VE.	6.4	.6	6.6	2.2	3.1	11.4
	Nor. VE.	7.0	.0	5.6	2.3	2.9	10.9
	Rap. VE.	5.7	.2	5.7	1.9	3.5	13.2

The economy of rapid reading.- Table X presents the average rate and comprehension of careful reading and rapid reading obtained by the testing technique. The data show that for the same group of subjects an increase in rate from careful reading to rapid reading results in very little loss in the average comprehension. The average number of words per second for careful and rapid reading of literary Chinese is 3.8 and 5.7 respectively, a difference of approximately two words per second; for vernacular Chinese, 4.9 and 7.0 respectively, a difference of about two words per second. The average comprehension scores for careful and rapid reading of literary Chinese are 80 and 75 respectively, a difference of 5 points; for vernacular Chinese, 89 and 83 respectively, a difference of 6 points. In terms of

percentage, the increase of rate from careful reading to rapid reading varies from 42 to 52 per cent; the loss in comprehension varies from 6 to 7 per cent. Thus when rate and comprehension are both taken into account, the greater efficiency for rapid reading is quite evident.

TABLE X

A COMPARISON OF THE AVERAGE RATE AND COMPREHENSION BETWEEN RAPID READING AND CAREFUL READING OBTAINED BY THE TESTING TECHNIQUE

Methods of Reading	Rate Words per Second	Comprehension
Rapid reading of lit. fiction	5.69±.35	74.8±1.8
Careful reading of lit. fiction	3.75±.14	80.0±1.4
Diff. between rapid & careful reading	1.94±.24	5.2±1.7
Diff. in terms of percentage, from rapid to careful reading	34.09	6.95
Diff. in terms of percentage, from careful to rapid reading	51.73	6.50
Rapid reading of ver. fiction	7.02±.32	83.0±1.2
Careful reading of ver. fiction	4.94±.18	88.5±0.9
Diff. between rapid & careful reading	2.08±.18	5.5±1.2
Diff. in terms of percentage, from rapid to careful reading	26.63	6.63
Diff. in terms of percentage, from careful to rapid reading	42.11	6.21

The superiority of rapid readers.- Test results reveal a slight positive correlation between rate and comprehension, as shown in Table XI, which varies from .029 to .280. When the 50 subjects were divided into three speed groups, the fast group, containing the 12 fastest readers, the medium group, containing the medium 26 readers, and the slow group, containing the 12 slowest readers, the average comprehension scores for the three groups are 84.1, 80.2, and 79.2 respectively. The average rate in terms of number of words per second for the three speed groups is as follows respectively: 9.7, 5.0, and 3.1 for the rapid reading of literary Chinese; 5.8, 3.6, and 2.2 for the careful reading of literary Chinese; 10.6, 6.8, 3.9 for the rapid reading of vernacular Chinese; and 7.6, 4.7, and 2.8 for the careful reading of vernacular Chinese. Thus when both rate and comprehension were taken into account, the greater efficiency for the rapid readers is quite evident.

TABLE XI

CORRELATIONS BETWEEN RATE AND COMPREHENSION IN READING THE VARIOUS SELECTIONS OBTAINED BY THE TESTING TECHNIQUE

Methods of Reading	Materials	Correlations
Careful Reading	LE. (1 & 2)	.029±.095
	LF. (3 & 4)	.280±.088
	VE. (5 & 6)	.140±.094
	VF. (7 & 8)	.076±.095
	LF. (9)	.174±.092
	VF. (10)	.058±.095

The relative constancy of rate.- The evidence of the study shows that the relative position of an individual's rate of reading in the group is fairly constant. In other words, a rapid reader in one type of reading is likely to be a rapid reader in other types of reading. The correlations of rate of reading between different types of materials, between the same types of material and between the results obtained by different methods of reading are presented in Table XII. The average correlation between the reading rate of literary and vernacular Chinese is .82; the average correlation between the reading rate of fiction and essays is .84; the average correlation between the results obtained from different methods of reading is about .74; and the average correlation between reading rate of the same types of material by the same method is .89.

TABLE XII

CORRELATIONS OF RATE OF READING BETWEEN DIFFERENT TYPES OF MATERIALS, BETWEEN THE SAME TYPES OF MATERIAL, AND BETWEEN THE RESULTS OBTAINED FROM DIFFERENT METHODS OF READING

Records	Types of Correlations	Correlation Coefficient*
Photo.	Nor. reading of lit. & ver. essays	.826±.031
	Nor. reading of lit & ver. fiction	.895±.018
	Rap. reading of lit. & ver. essays	.721±.055
	Car. reading of lit. & ver. essays	.868±.030
	Nor. reading of lit. & ver. essays**	.823±.044
Test	Car. reading of lit. & ver. essays	.778±.037
	Car. reading of lit. & ver. fiction	.894±.018
	Rap. reading of lit. & ver. fiction	.721±.046

TABLE XII (CONTINUED)

Records	Types of Correlations	Correlation Coefficient*
Photo.	Nor. reading of lit. essay & lit. fiction	.862±.025
	Nor. reading of ver. essay & ver. fiction	.857±.025
Test	Car. reading of lit. essay & lit. fiction	.779±.037
	Car. reading of ver. essay & ver. fiction	.864±.025
Test	Car. reading of two lit. essay selections	.888±.022
	Car. reading of two lit. fict. selections	.888±.022
	Car. reading of two ver. essay selections	.868±.025
	Car. reading of two ver. fict. selections	.902±.018
Photo.	Car. & nor. reading of lit. essays	.817±.031
	Car. & nor. reading of ver. essays	.700±.058
	Car. & rap. reading of lit. essays	.797±.036
	Car. & rap. reading of ver. essays	.616±.070
	Nor. & rap. reading of lit. essays	.694±.051
	Nor. & rap. reading of ver. essays	.595±.073
Test	Car. & rap. reading of lit. fiction	.838±.028
	Car. & rap. reading of ver. fiction	.884±.022

*Pearson product-moment correlation coefficient.

**Original literary passage and its vernacular translation passage.

The reading of English and Chinese.- The principles explaining the complex reading processes involved in the reading of English and Chinese are, in many respects, essentially the same. But, the spatial distribution of fixations along a line are strikingly different in the reading of these two languages. The square shape of the Chinese words and their compact arrangement in a line demand eye-movements of a smaller spatial distance and a greater number of fixations per line than is the case in the reading of English. But, when comparison is based on the average number of words per fixation, not in the absolute spatial unit, the span of recognition in reading Chinese is on the whole larger than that in the reading of English. The average fixation-duration in the reading of English, however, is shorter than that in the reading of Chinese. These differences are probably due to differences in the forms of the words of these two languages.